Yanbu Industrial College

Department of Electrical Power Engineering Technology

EEET 103 Electrical Machines I

Lab Exercise No. 13

Title **DETERMINATION OF FACTORS AFFECTING THE DIRECTION OF ROTATION OF UNIVERSAL MOTORS**

Student Name: _____ **Student ID:** _____

Submission Date: _____ **Lab Section:** _____

Important Notes

1. Every student must write Name, Section, and Lab exercise No, Title, ID Number and Submission Date clearly in provided space.
2. Only neat, clean and hand written reports on this prescribed format given in E-learning will be accepted.
3. Students are encouraged to work and study together as team work is highly recommended.
4. No credit will be given for works that are copied from any source.
5. Assignments and reports must be turned in on time.
6. Please make photocopy of your lab report before submission as original may not be returned to you.
7. In case of late submission 20% of total credits will be reduced per day.

For Instructor's use only.	
Date Received	
Maximum Marks	**10**
Late By	**days**
Deductions	**%**
Marks Obtained	
Comments (If any)	

Signature: _____

DETERMINATION OF FACTORS EFFECTING THE DIRECTION OF ROTATION OF UNIVERSAL MOTOR

PERFORMANCE OBJECTIVES:

Upon completion of this laboratory exercise, the students will be able to

- Define the factors effecting the direction of rotation of universal motors
- Make the connections necessary to produce the desired direction of rotation.

EQUIPMENT:

1. DM-100 DC Motor.
2. 0-140 volt Hampden variable AC power supply.
3. 0-125 volt Hampden variable DC power supply.
4. Two Digital Multimeters.
5. Tachometer.

DISCUSSION:

Universal motor is the name used for small series motor which are designed so that they can be operated from a DC or an AC supply of the same rated voltage. Universal motors are used extensively for appliances and the driving of hand tools. Universal motors have series characteristics so that they run at their rated speed only on the rated load. If the load is reduced, the speed will rise. Such motors are suitable for driving fans, vacuum cleaners, domestic sewing machines, portable tools, etc. As brush wear takes place more rapidly in universal motors so they are not generally considered suitable for long hour duty. The no-load speed of a universal motor, unlike other machine is very high.

Therefore, the motor is smaller in size than other type for a given load. Universal motor gives more torque per ampere than any other single-phase motor. It is therefore used where light weight and high torque are important.

CAUTION!

1. **High voltages are present in this experiment. Do not make any connections with the power on. The power should be turned off after completing measurement**

DETERMINE THE DIRECTION OF ROTATION OF UNIVERSAL MOTOR CONNECTED TO DC SUPPLY

CIRCUIT CONNECTIONS:

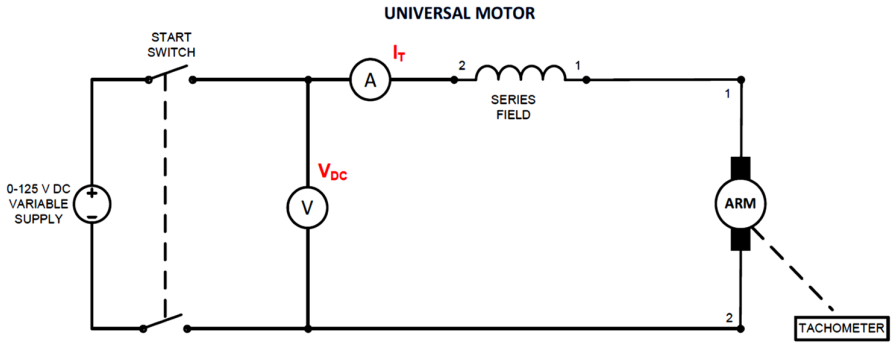

Figure 1.1

PROCEDURE:

1. Connect the series field in series with the armature and hook up the motor to the power supply as shown in figure 1.1. Do not turn the power on yet.
2. Turn the knob of the 125-volt supply to zero
3. Turn on the main circuit-breaker switch, turn on the 125-volt dc supply circuit-breaker switch and turn on the motor circuit-breaker switch.
4. Slowly increase the voltage until the armature starts to run. Do not exceed 30 volts.
5. Note of direction of rotation, voltage and speed in the table of observations.
6. Turn off all circuit breaker switches.

OBSERVATIONS:

Supply Voltage (DC) V_{IN}	Direction of Rotation	Rotation Speed rpm

CIRCUIT CONNECTIONS:

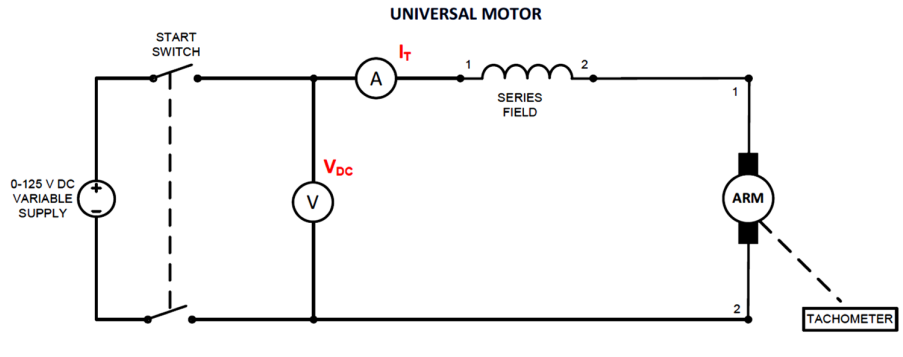

Figure 1.2

PROCEDURE:

7. Disconnect the Series Field winding leads and reconnect them as shown in figure 1.2. Note that with the field winding leads reversed, the direction of the magnetic field is reversed.
8. Turn the knob of the 125-volt supply to zero.
9. Turn on the main circuit-breaker switch, turn on the 125-volt dc supply circuit-breaker switch and turn on the motor circuit-breaker switch.
10. Slowly increase the voltage until the armature starts to run. Do not exceed 30 volts.
11. Note of direction of rotation, voltage and speed in the given observations table.
12. Turn off all circuit breaker switches.

OBSERVATIONS:

Supply Voltage (DC) V_{IN}	Direction of Rotation	Rotation Speed rpm

DETERMINE THE DIRECTION OF ROTATION OF UNIVERSAL MOTOR CONNECTED TO AC SUPPLY

CIRCUIT CONNECTIONS:

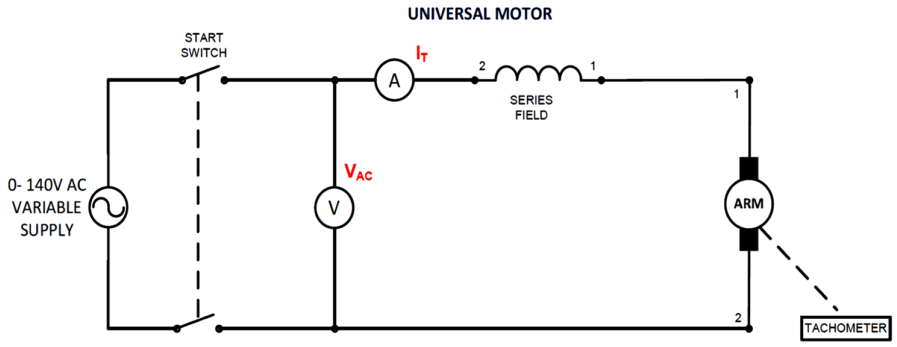

Figure 1.3

PROCEDURE:

1. Connect the series field in series with the armature and hook up the motor to the AC power supply as shown in figure 1.3. Do not turn the power on yet.
2. Turn the knob of the 140 AC-volt supply to zero
3. Turn on the main ac circuit-breaker switch, turn on the 140-volt AC supply circuit-breaker switch and turn on the motor circuit-breaker switch.
4. Slowly increase the voltage until the armature starts to turn. Do not exceed 30 volts. Note of direction of rotation, voltage and speed in the given observations table.
5. Turn off all circuit breaker switches.

OBSERVATIONS:

Supply Voltage (AC) V_{IN}	Direction of Rotation	Rotation Speed rpm

CIRCUIT CONNECTIONS:

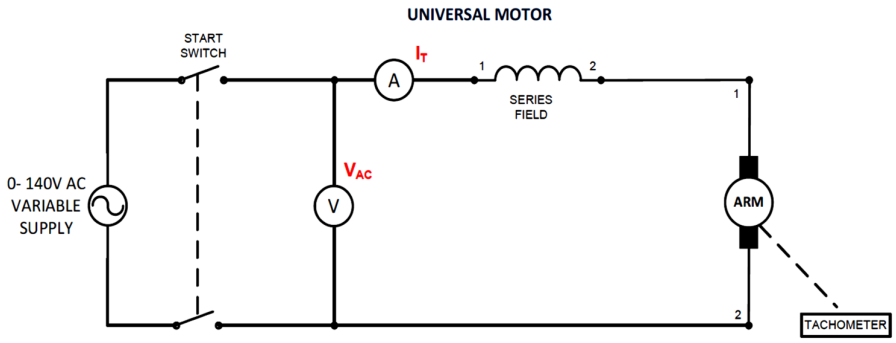

Figure 1.4

PROCEDURE:

13. Disconnect the series field leads the reconnect them as shown in figure 1.4.Note that with the polarity of the series field connections reversed the direction of the main magnetic field is reversed.
14. Turn the knob of the 140 AC-volt supply to zero
15. Turn on the main ac circuit-breaker switch, turn on the 140-volt AC supply circuit-breaker switch and turn on the motor circuit-breaker switch.
16. Slowly increase the voltage until the armature starts to turn. Do not exceed 30 volts. Note of direction of rotation, voltage and speed in the given observations table.
17. Turn off all circuit breaker switches.

OBSERVATIONS:

Supply Voltage (AC) V_{IN}	Direction of Rotation	Rotation Speed rpm

REPORT

Prepare a report containing:

1. Diagrams of each circuit.
2. All tables.
3. Graph on a grid paper.
4. All calculations and required data.
5. Answers to questions.

REVIEW QUESTIONS

1. For the same terminal voltage, a universal/DC motor runs at higher speed from AC supply than DC supply.

- [ ] a True
- [ ] b False

2. For the same terminal voltage, a universal/DC motor develops more power output when operated from DC supply than from AC supply.

- [ ] a True
- [ ] b False

3. For a particular applied voltage, the back EMF in case AC series motor is less than the back EMF in case of DC series motor.

- [ ] a True
- [ ] b False

4. In hand tool applications the single phase motor use as:

- [ ] a Shaded pole motor.
- [ ] b Capacitors start motor.
- [ ] c Capacitors run motor.
- [ ] d DC series motor.

5. What changes are necessary in a DC series motor to adapt it for operation from an AC power source?

_____

_____

_____

6. How can the direction of rotation of a universal/DC motor be changed?

_____

_____

_____

7. What is meant by **Universal Motor**?

8. List three applications of a universal motor.

9. How the speed of a universal motor can be controlled?

10. What is wrong about operating a universal motor at no-load with nominal voltage?

11. Name one option for speed control of a universal motor.

FINAL CHECKLIST

All the students must make sure, before they leave the Lab:

1. Turn the value of variable power supplies and resistive load to zero
2. Main power switch on the work bench is put "OFF".
3. All the connection of machines/ equipment is removed.
4. All machines/meters are properly placed (slide in) either in storage cabinet or in work station itself.
5. All connecting leads are sorted out according to their length and colours and placed on the hooks provided in the side of the work station.
6. Submit your answers to the questions, together with your data, calculations (if any) and results before the next laboratory sessions.